Unpacking the Effect of Acculturation on Pain Sensitivity

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Abstract of thesis entitled: Unpacking the Effect of Acculturation on Pain Sensitivity

Differences in pain sensitivities have been found between immigrants and non-immigrants. This thesis further examines the effect of acculturation on pain sensitivities. Acculturation is a process that is filled with unfamiliarity, which is associated with heightened pain sensitivities. It is predicted that indicators of familiarity of host culture, such as length of stay, should predict pain sensitivities, while variables that counteract the effect of unfamiliarity, such as mainstream acculturation and perceived control, should attenuate the effect of acculturation on pain. Two studies have been done to test these hypotheses. Study 1 was a laboratory study which investigated the heat pain responses of immigrants from mainland China. It was found length of stay predicted pain threshold and tolerance positively. The effect is moderated by mainstream acculturation and perceived control (as indicated by SES). The effect of length of stay was stronger for immigrants with high mainstream identification. The effect of length of stay was stronger for immigrants with low SES. Study 2 was a field study examining pain during blood donation. Immigrants had a higher rating of finger-pricking pain than non-immigrants. Perceived control moderated this relationship such that the effect of immigration status was stronger for those with low perceived control. The effect of acculturation on pain was replicated across laboratory and field settings. These results also point to the role of perceived control in attenuating the effect of acculturation on pain.

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論文摘要：

本論文探討適應新文化對痛楚感觀的影響。在適應文化的過程，人會不斷面對不熟悉的情況，而不熟悉感會加強痛楚的感觀。跟據這推論，標誌著熟悉感的因素，如居住時期，該能預測痛楚感觀。而緩和不熟悉感的因素，如文化認同及主觀控制能力，該能改變文化適應對痛楚感觀的影響。這論文有兩個研究去考證這假設。第一個研究邀請了由內地移民到香港的人士參加實驗，量度他們對熱力所產生的痛楚的反應。結果顯示，居住時期越長，感覺到痛楚的起點和痛楚承受程度都越高。對於居住相對長時間的移民人士，認同主流文化比不認同的有著較高的痛楚承受程度。對於居住相對短時間的移民人士，主觀控制能力高的有著較高的痛楚承受程度。第二個研究在捐血中心收集了問卷。移民人士比非移民人士更認爲刺手指痛。主觀控制能力較低的移民人士亦比主觀控制能力高的更認爲刺手指痛。在實驗室和實地的研究都指出了適應新文化對痛楚感觀的影響。主觀控制能力似乎是減弱不熟悉感對痛楚的影響的一個重要因素。

论文摘要：

本论文探讨适应新文化对痛楚感观的影响。在适应文化的过程，人会不断面对不熟悉的情况，而不熟悉感会加强痛楚的感观。跟据这推论，标志着熟悉感的因素，如居住时期，该能预测痛楚感观。而缓和不熟悉感的因素，如文化认同及主观控制能力，该能改变文化适应对痛楚感观的影响。这论文有两个研究去考证这假设。第一个研究邀请了由内地移民到香港的人士参加实验，量度他们对热力所产生的痛楚的反应。结果显示，居住时期越长，感觉到痛楚的起点和痛楚承受程度都越高。对于居住相对长时间的移民人士，认同主流文化比不认同的有着较高的痛楚承受程度。对于居住相对短时间的移民人士，主观控制能力高的有着较高的痛楚承受程度。第二个研究在捐血中心收集了问卷。移民人士比非移民人士更认为刺手指痛。主观控制能力较低的移民人士亦比主观控制能力高的更认为刺手指痛。在实验室和实地的研究都指出了适应新文化对痛楚感观的影响。主观控制能力似乎是减弱不熟悉感对痛楚的影响的一个重要因素。

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Introduction

Acculturation is a process of intercultural contact that results in changes in the psychology of an individual (Berry, 1997). The level of acculturation is associated with various outcomes among immigrants. In terms of physical health, the level of acculturation is related to obesity (Unger et al., 2004), and chronic disease (Kaplan et al., 2002). In terms of psychological health, the level of acculturation is related to anxiety and depression (Hwang & Ting, 2008; Yeh, 2003). In terms of sociocultural adjustment, it is predictive of social competence among immigrants (Hsu et al., 2012). In terms of pain, ethnic differences have been found between European American and ethnic minority groups, and evidence has suggested the effect of acculturation on pain responses. The underlying mechanism has not been examined. The research question, how acculturation impacts on pain responses, is addressed in this thesis.

Ethnic differences in pain sensitivities

This thesis examines the effects of acculturation on pain. This idea stems from studies that investigated ethnic differences in pain. Extensive research has found that minority groups in the US have a greater pain sensitivity[1] than European Americans in both laboratory and clinical settings (Edwards, Fillingim, & Keefe, 2001). For example, African Americans reported a lower pain tolerance than European Americans in laboratory studies, and they reported a higher level of pain intensity and unpleasantness of their chronic pain in clinical setting (Edwards et al., 2001). Underlying reasons such as the lack of access to health care system, discrimination,

[1] Pain sensitivities generally refer to pain threshold and tolerance, and sometimes the ratings of pain in visual analogue scale (Rahim-Williams et al., 2007).

ethnic-specific coping strategy and pain belief have been suggested (Edwards et al, 2001).

Pain sensitivities of Asian American and European American have also been compared. Interestingly, despite the stereotype of Asian being more stoic about pain, research indicates that Asian American actually have more heightened pain responses compared to European American. For example, in one study South Asians in the UK had a lower pain threshold and higher pain intensity rating when compared to White British participants (Watson, Latif, & Rowbotham, 2005). Similarly, Chinese living in Canada had a lower pain tolerance than Caucasian as measured by a cold pressor task (Hsieh, Tripp, Ji, & Sullivan, 2010).

However, there may be another factor that can explain the ethnic differences. The Asian participants examined in these studies are all first-generation immigrants who are presumably going through adjustment process to a new culture. In contrast, European American samples used were exclusively natives who are not undergoing any acculturation process. Thus, acculturation may account for the differences observed between Asian American and European American.

Studies have been done to test this idea (Chan, Hamamura, & Janschewitz, 2013). The first study was conducted in the US comparing first-generation, second-generation Asian American, and Caucasian participants on their pain sensitivities (referring to both pain threshold and tolerance). Only first-generation Asian American participants showed more heightened pain sensitivities than the other two groups. Ethnicity was further controlled by comparing only Chinese in study 2. Hong Kong Chinese who were non-immigrants were compared with mainland Chinese immigrants in Hong Kong. Hong Kong participants demonstrated a higher

pain threshold and tolerance than mainland Chinese participants. Importantly, pain sensitivities of the Hong Kong Chinese participants in Study 2 were comparable to that of European American participants in Study 1. All these evidences suggest the role of acculturation in accounting for the ethnic differences in pain sensitivities.

Why acculturation has an effect on pain?

Acculturation is a process of intercultural contact that results in changes in the psychology of an individual (Berry, 1997). Acculturation can be conceptualized as a "longitudinal trajectory of cultural adaptation" (Schwartz, Unger, Zamboanga, & Szapocznik, 2010). It can also be viewed as a process of achieving control over the new cultural environment (Berry, 2006).

Acculturation is composed of situations of unfamiliarity, uncertainty, and unpredictability. Immigrants have to navigate through unfamiliar customs, social norms, language, and values in the new place. Apart from the physical environment, immigrants have to interact in an environment where social cues and rules of behaviors are unclear to them (Padilla, Alvarez, & Lindholm, 1986).

Situations of unpredictability, unfamiliarity, and lack of control that are frequent in acculturation may lead to higher pain sensitivities. It was found that unpredictability heightens the aversiveness of pain. For example, unpredictable shocks were rated as more painful and lead to a heightened pain sensitivity (Rhudy et al., 2006; Rhudy & Meagher, 2000). When participants did not have control over the duration of pain task, pain tolerance was decreased (Litt, 1988). Unpredictable noise lead to greater heat pain responses (Rhudy & Meagher, 2001). Similar pattern was found for those who were not able to choose their own background music as

compared to those who have the choice (Mitchell, MacDonald, & Knussen, 2008). These suggest that unpredictability and uncontrollability heightens pain sensitivity.

Deriving prediction from this perspective, familiarity of an environment in acculturation process may be negatively associated with pain sensitivity. As such, I predict that variables that indicate immigrants' familiarity of host culture, such as length of stay, would predict pain sensitivities. Similarly, variables that would counteract the effect of unfamiliarity, such as mainstream identification and perceived control, should moderate the relationship between acculturation and pain.

Control, which is reviewed below, is proposed as a moderator in this research. Acculturation entails exposing migrants to unfamiliarity, e.g. language, social norms, cultural practices. However, acculturation may not necessarily entail a lower degree of control. For example, immigrants with East Asian cultural background moving to more individualistic countries may experience more control and choices in daily lives, but this would be an unfamiliar cultural belief to East Asian immigrants. Since the main effect of interest is acculturation, unfamiliarity, rather than control, is focused as the main effect variable.

Length of stay and pain

One way to operationalize familiarity of a place is the length of stay in a new country. It indicates the length of physical presence in a new cultural environment. As immigrants live longer in a new country, the familiarity with host culture tends to increase. More exposure to host culture and more opportunities of intercultural contact are available as length of stay increases. Increased intercultural contact likely leads to acquisition of skills to negotiate in the new culture (Ward & Kennedy, 2001).

In general, familiarization of the host culture is assumed to be increasing steadily over time.

In prior research, length of stay is associated with greater familiarity with the host culture, language, and social norms. For example, language proficiency tends to increase as immigrants live longer in host culture (Miglietta & Tartaglia, 2009). Immigrants who have a longer length of stay tend to have more host cultural members in their social network (Ying et al., 2000). Length of stay is also predictive of psychological well-being (Ward, Okura, Kennedy, & Kojima, 1998). Early immigrants were found to have a lower level of depression and anxiety than recent immigrants (Bagley, 1993).

In sum, as time spent in a new culture increases, familiarity of the culture increases. To the extent that pain sensitivities decrease with increasing familiarity of environment, it is predicted that length of stay is negatively associated with pain sensitivities.

Moderation effect of mainstream identification

Length of stay is a simple proxy measure of acculturation. It is generally assumed that as the amount of exposure increased, familiarity of a place is also increased (Ryder, Alden, & Paulhus, 2000). However, length of stay may not fully capture individual differences in acculturation. For example, length of stay does not indicate immigrants' participation in the host culture and willingness of contact with host cultural members (Ryder et al., 2000). As length of stay increases, more exposures and opportunities are available for intercultural contact; but this process is likely to be qualified by their willingness of participating in the host culture.

A higher mainstream identification may indicate less disorienting and confusing experience in host culture. In prior research, mainstream identification was associated with a higher social competence (Ryder et al., 2000) and less social adjustment problems when interacting with host culture people (Ryder, Alden, Paulhus, & Dere, 2013).

For immigrants with high mainstream identification, they may have actively engaged themselves in the host culture throughout the staying period. This results in a stronger familiarity with the host cultural norms and environment. For immigrants with low mainstream identification, it may reflect their separation from the host culture. With a negative attitude and responses to host culture, they may not be familiar with the culture even with a long period of time staying.

Therefore, it is predicted that the relationship between length of stay and pain would be moderated by mainstream identification. To the extent that mainstream identification indicates familiarity of host culture with active participation, the effect of length of stay would be stronger among individuals with high mainstream identification.

Moderation effect of control

Besides indicators of familiarity, variables that may counteract with the effect of unfamiliarity are likely to moderate the relationship between acculturation and pain. In face of an uncertain environment, individual differences in perceived control are likely to counteract this situational effect.

Belief of control is about the relationship between behaviors and the environment. Individual with internal locus of control believe that outcomes are contingent on their behaviors and personal effort; whereas individuals with external locus of control believe that outcomes are contingent on factors outside of their personal control, such as chance, fate, and luck (Rotter, 1966).

It has been suggested that, the belief about controllability of external events would have its greatest effect under ambiguous situation (Rotter, 1966). Under a novel situation, there is minimal cue indicating the controllability of events. Thus, individuals have to rely on their general belief of control to gauge the controllability of the environment. Under highly ambiguous situation, individuals with internal locus of control may appraise the situation as more controllable than those with external locus of control (Folkman, 1984).

Migrating to a new cultural environment is likely to constitute an ambiguous and novel environment. In the initial stage of acculturation, immigrants may not be familiar with the culture, and their belief of control may influence on their perceived controllability of the environment. Immigrants with high perceived control may view the new cultural environment as more controllable than those with low perceived control (Ward & Kennedy, 1992.) High perceived control may attenuate the effect of unfamiliarity on pain.

Therefore, it is hypothesized that the effect of length of stay on pain would be moderated by perceived control. To the extent that individuals with higher perceived control appraise new cultural environment as more controllable, the effect of length of stay on pain would be weaker among individuals with high perceived control.

SES

One indicator of perceived control is socioeconomic status (SES). SES indicates the capability of mobilizing resources to gain control in life (Marmot, 2004). SES shapes beliefs about control through socialization from childhood to adulthood. Social hierarchy implicates unequal portion of resources and access to opportunity (Gallo & Matthews, 2003). In prior research, higher SES was associated with higher perceived control (Gallo, Bogart, Vranceanu, & Matthews, 2005; Christie & Barling, 2009; Marmot, 2004). Parents' educational level was used as a measure of SES in this study. As parents with higher educational status often have more knowledge and awareness of their children's school work, they can afford more involvement and resources into their children's education (Moreno & Lopez, 1999). This may grant higher sense of control to students.

Having a higher SES is associated with better adjustment outcomes during acculturation (Ataca & Berry, 2002). Ward & Kennedy (1999) found that recent immigrants with higher SES tend to have a lower level of adaptation difficulties. Sojourners with a higher SES were more willing to interact with host cultural people (Brein & David, 1971; Negy & Woods, 1992).

To the extent that SES indicates perceived control, the effect of length of stay on pain would be weaker among individuals with high SES. It is hypothesized that SES would moderate the relationship between length of stay and pain. This possibility is tested in study 1.

Perceived control

Although SES generally indicates an individual's perceived control, it may indicate other factors, such as access to health care and health behaviors, that also have an effect on pain. Using a subjective measure of perceived control can further testify its role in moderating the relationship between length of stay and pain.

Research shows that subjective measure of perceived control is predictive of adjustment outcomes. Lower level of perceived control was associated with more psychological symptoms among a group of sojourners from New Zealand residing in Singapore (Ward et al., 1992). Another group of sojourners from Europe and North American countries residing in Nepal reported a similar pattern (Ward & Rana-Deuba, 2000).

To the extent that perceived control indicates an individual's belief of controllability of the environment, the effect of acculturation on pain should be weaker among individuals with high perceived control. Therefore, it is hypothesized that perceived control would moderate the relationship between acculturation and pain. This possibility is tested in study 2.

Hypothesis and study overview

In study 1, pain sensitivities were investigated among a sample of immigrants from mainland China in Hong Kong in a laboratory setting. Acculturation was operationalized as their length of stay. Pain sensitivity was operationalized as pain threshold and tolerance, such that a higher sensitivity is evidenced as lower pain threshold and tolerance. It is hypothesized that length of stay would be positively

associated with pain threshold and tolerance. Moreover, it is hypothesized that mainstream identification would moderate the relationship such that the effect of length of stay on pain is stronger among more high mainstream cultural identifiers. It is also hypothesized that SES would moderate the relationship such that the effect of length of stay on pain sensitivity is weaker among immigrants with high SES.

In study 2, pain sensitivities were measured as ratings of pain during blood donation. Acculturation is operationalized as immigration status. It is hypothesized that immigrants would have higher pain ratings than non-immigrants. It is also hypothesized that the relationship between immigration status and pain ratings would be moderated by perceived control, such that the effect of immigration status on pain ratings would be stronger for those with low perceived control.

Figure 1 depicts the conceptual model across both studies (p.26).

Study 1

Method

Participants

The study collected 80 participants. They were all immigrants from mainland China with 40 male and 40 female with age ranged from 17 to 27 (M = 21.45, SD = 1.77). Their length of stay in Hong Kong ranged from 3 to 20 years (M = 11.13, SD = 4.63). Participants were recruited from mass mail which is circulated around the Chinese University of Hong Kong. They were compensated with HK$50 for participation. The statistics of demographics were reported in Table 1.

Materials and Measures

Prior research found that pain modalities (e.g. pain from cold, heat, pressure, and shock) have different properties (Nielsen et al., 2008; Rainville, Feine, Bushnell, & Duncan., 1992). The effect of acculturation was found with cold pressor pain (Chan et al., 2013), and replication with different pain modalities is warranted. For this reason, heat pain was used instead of cold pain in this study.

Thermal stimuli were delivered using a heat device with a contact surface area of 25mm^2 (diameter = 1cm). Thermal stimuli were delivered to the forearm where the testing area of each participant was fixed. Every trial starts from 35°C and the thermal temperature increased at a rate of 0.25°C/s. To avoid any tissue damage, the cut-off temperature was set to be 52°C. To capture pain threshold, participants were instructed to say "now" when they first felt painful. The temperature at which they reported "now" was recorded. The average of the 4 temperatures at which they reported "now" was taken as pain threshold (α = .91). To capture pain tolerance, participants were instructed to try to tolerate as much pain as they could. When they could no longer stand the pain, they would say "stop", and the temperature at which

they reported "stop" was recorded (α = .98). The average of the 4 temperatures at which they reported "stop" was taken as pain tolerance.

Participants' acculturation was measured by Vancouver Index of Acculturation, which separately assesses identification with Hong Kong culture and heritage culture (Ryder et al., 2000). It was measured with a 9-point Likert scale. Heritage identification and mainstream identification scores were obtained by averaging the respective 10 items. The alphas for the present study were: heritage = .90, mainstream = .85.

Socioeconomic status (SES) was measured by the educational level of participants' parents.

Table 2 provides the correlations among variables.

Procedure

The whole experiment was conducted in Cantonese. Participants first completed an online survey, then they proceeded to the heat pain experiment. The two tasks were separated by at least one day.

Before the experiment begins, participants were made familiarized with the device and walked through the procedure thoroughly. First, experimenter explained the whole procedure to participants. Then, experimenter applied the thermal stimuli on participant's finger so that he or she would have a chance to try touching the contact point to familiarize themselves with the device and the temperature.

A transparent plastic sheet with 8 holes was attached to the arms of participants in order to standardize the location at which the measurement takes place. Each hole was pre-set to be testing a particular measure at a particular order. All participants were tested 4 times of pain threshold first, which was followed by 4

trials of pain tolerance testing. Each trial was separated by 1 minute to avoid habituation or sensitization of the sensory cell. Participants were debriefed upon the completion of the study.

Results

Length of stay on pain

As hypothesized, length of stay was significantly associated with pain threshold, $\beta = .35$, $p = .001$, indicating that immigrants who stayed in HK for a longer time had higher pain threshold than those with a shorter length of stay. The association between length of stay and pain tolerance was marginally significant, $\beta = .19$, $p = .099$. Immigrants who stayed in Hong Kong for a longer while also tend to have a higher pain tolerance.

The moderating role of mainstream identification

To test the moderating effect of mainstream identification, a regression model analysis was used. All variables were standardized before putting into the analysis.

For pain threshold, the interaction term was not significant, $\beta = .16$, $p = .167$. For pain tolerance, the interaction term was significant, $\beta = .39$, $p = .001$ [Table 3]. The effect of length of stay on pain tolerance was stronger for high mainstream identifiers. For participants with high mainstream identification (+1 SD), length of stay was positively associated with pain tolerance, $\beta = .46$, $p = .001$, whereas for those with low mainstream identification (-1 SD), length of stay did not predict pain tolerance, $\beta = -.23$, $p = .146$. [Figure 2]

The moderating role of SES

To test the moderating effect of SES, a regression model analysis was used. All variables were standardized before putting into the analysis.

For pain threshold, the interaction term was not significant, $\beta = -.18$, $p = .104$. For pain tolerance, the interaction term was significant, $\beta = -.25$, $p = .022$ [Table 4]. The effect of length of stay on pain tolerance was weaker for those with high SES. For participants with high SES (+1 SD), length of stay did not predict pain tolerance, $\beta = .06$, $p = .655$, whereas for those with low SES (-1 SD), length of stay predicts pain tolerance positively, $\beta = .52$, $p = .002$ [Figure 3].

Discussion

In summary, length of stay predicted both pain threshold and tolerance. The longer mainland Chinese immigrants have stayed in Hong Kong, the higher their pain threshold and tolerance. Mainstream identification moderated the relationship such that the effect of length of stay was stronger for immigrants with high mainstream identification, presumably because of their active participation and greater familiarity of the host culture. SES also moderated the relationship such that the effect of length of stay was weaker for immigrants with high SES, presumably because of their higher perceived control over the environment.

However, the moderation effects of mainstream identification and SES were only found for pain tolerance but not pain threshold. Such discrepancy may be attributable to the differences between pain threshold and tolerance. Pain threshold reflects the sensory aspect of pain whereas pain tolerance reflects the affective-motivational aspect of pain (Mechlin et al., 2005). Since length of stay indicates the

duration of physical presence and familiarity in a new cultural environment, it may have a stronger predictive power over pain threshold. As both moderators are psychological variables, they may be predictive of pain tolerance more than pain threshold.

Study 2

Laboratory-induced pain may be quite different from naturally occurring pain. They may differ on controllability, duration of stimulus, intensity, and meaning (Edwards, Sarlani, Wesselmann, & Fillingim, 2005). Therefore, whether the finding of acculturation effect on pain is generalizable to real-world setting warrants further investigation. Examining the theory with naturally occurring pain can test the external validity of the theory. As such, study 2 examined the theory in a field study. Surveys were conducted in a blood donation campaign. It is hypothesized that immigrants would have higher pain ratings than non-immigrants. It is also hypothesized that the effect of immigration status on pain ratings would be stronger for those with lower perceived control.

Method

Participants

Participants were 151 individuals (average age = 20.27) who donated their blood at a blood donation center on a university campus during the blood donation campaign. Of these, 103 participants were born in Hong Kong and had not been away for more than one year (50.5% female) and 48 were born in mainland China (60.4% female). Among those born in China, their length of stay in Hong Kong

ranged from 0.17 to 19 years (M = 5.40, SD = 6.15). The statistics of demographics were reported in Table 5.

Materials and Measures

Pain intensity was measured by visual analog scale (VAS) ranged from 0 "not painful at all" to 100 "extremely painful". This is a commonly used tool for assessing pain ratings in blood donation (Ditto et al., 2003; France, Adler, France, & Ditto, 1994). The question was asked for the two different kinds of pain – one for finger-pricking pain and the other for needle-insertion pain, as detailed under procedure.

Perceived control was measured by asking "how much control do you think you have over the procedure?" ranged from 0 "completely no" to 5 "completely yes". Due to limited time allowed for survey completion in the center, a single item for this construct was used.

Correlations among variables were reported in Table 6.

Procedure

Data collection was conducted during a blood donation campaign in CUHK, the duration of which was one week. At first, blood donors have to undergo an initial blood sample procedure, during which they have to endure the pain of finger-pricking to see if they were suitable for blood donation. Then they would undergo needle insertion for blood donation. After which, they were free to sit down and rest for 5 minutes before leaving. They were asked to participate in this study during their rest in the refreshment area. A piece of chocolate was given as the compensation of participating in the study.

Results

Greater pain of the initial finger pricking was reported among the participants born in mainland China (M = 31.45, SD = 21.55) relative to those born in Hong Kong (M = 25.24, SD = 19.98), $t(149) = -1.73$, $p = .085$. However, the two groups did not differ on the pain ratings for the blood donation (immigrants: M = 30.10, SD = 19.11, non-immigrants: M = 30.30, SD = 18.96), $t(149) = 0.06$, $p = .95$. Length of stay (including Hong Kong participants with age as length of stay) also correlated with finger-pricking pain rating, $\beta = -.18$, $p = .026$. But it did not correlate with needle-insertion pain rating, $\beta = -.06$, $p = .492$.

The moderating effect of perceived control on the relationship between immigration status and finger-pricking pain rating was tested. The interaction was significant, $\beta = -.20$, $p = .041$ (Table 7). The effect of immigration status on finger-pricking pain rating was stronger for participants with low perceived control. For participants with low perceived control (-1 SD), immigrants had a higher pain rating than non immigrants, $\beta = .32$, $p = .008$. Whereas for those with high perceived control (+1 SD), pain ratings did not differ between immigrants and non-immigrants, $\beta = -.03$, $p = .819$.

The interaction term between perceived control and immigration status was also tested on pain rating of needle insertion. Although it was not significant, $\beta = -.16$, $p = .101$, the pattern was similar to that of finger-pricking pain in that, the effect of immigration status on pain rating of needle insertion was stronger for those with low perceived control.

Discussion

In sum, immigrants and non-immigrants differed on their ratings on finger-pricking pain. The effect of immigration status on pain rating of finger-pricking was stronger for individuals with low perceived control. This further testified the effect of perceived control in moderating the effect of acculturation on pain.

Difference in pain ratings was only found for finger pricking but not needle insertion pain. Finger-pricking was undergone before needle insertion for blood donation. Their pain ratings on finger-pricking differed but needle insertion pain did not. It may reflect that the painful feelings of finger-pricking were more persistent for immigrants than for non-immigrants.

However, finger pricking may be a more consistent stimulus than needle insertion in terms of duration. The duration of finger pricking is consistent; whereas the duration of needle insertion for blood may vary depending on the donors' physical condition. Finger-pricking may also be more painful than needle insertion as there are more sensory cells in the finger tips. It should also be noted that this study may be subject to self-selection bias in that blood donors may be more altruistic and less fear of pain than the general population.

General Discussion

Across two studies, it was demonstrated that acculturation has an effect on pain. In study 1, length of stay was positively associated with heat pain sensitivities in a laboratory setting. In study 2, immigrants and non-immigrants differ on their finger-pricking pain rating in a blood-donation campaign. Moderators of the relationship were also found. The effect of acculturation on pain was qualified by mainstream acculturation. The effect of length of stay was stronger for those who actively participate in host acculturation. The effect of acculturation is also moderated by personal control such that it is weaker among immigrants those with high personal control. In study 1, the effect of length of stay was weaker for those with high SES. In study 2, the effect of immigration status was weaker for those with higher perceived control during blood-donation.

Findings of this research suggest the role of familiarity and controllability in influencing pain sensitivities during acculturation. Variables that indicate familiarity of the culture (length of stay, being immigrant or non-immigrant) predict pain sensitivity. Mainstream acculturation, which reflects participation in host culture, moderates the effects of length of stay on pain tolerance. To the extent that general belief about control dominates in appraisal of an ambiguous situation, SES and perceived control also moderate the relationship. The effect of acculturation on pain was evidenced among immigrants with low perceived control but not high perceived control, presumably based on their perceived controllability of the new cultural environment.

Predictability and controllability have been known to have an effect on pain. Pain stimuli that were perceived as predictable and controllable were less painful

(Rhudy et al., 2006; Litt, 1988); manipulating controllability of the environment prior to pain task also has an effect on pain (Rhudy et al., 2001; Mitchell et al., 2008). This research extends this phenomenon to a broader context; acculturation can be viewed as a relatively chronic experience of unfamiliarity. This research shows that it also has an effect on pain sensitivity. Unfamiliarity and unpredictability may implicate threats, and heightening pain sensitivity may be preparatory to detect such kind of threat (Rhudy et al, 2000).

In the current research, the conditions in which acculturation experience would have an effect on pain were identified. The process of acculturation is complex, and it is unlikely to be the same for every migrant. The outcomes of acculturation are often affected by various moderating factors (Berry, 1997). Investigating moderating variables of acculturation can increase the model's explanatory power and applicability (Sodowsky, Lai, & Plake, 1991; Schwartz et al., 2010). However, the current research adopts a cross-sectional design, which limits the inference of causality between familiarity of host culture and pain. Future study with longitudinal design is warranted.

One possibility for the underlying mechanism of acculturation effect on pain is stress. Stress has been implicated in the processes of pain response (Vachon-Presseau et al., 2013). However, data from our current studies did not support this idea. One reason is that the stress entailed by unfamiliarity in the environment may not be captured by self-report scales but more indicated by automatic physiological arousal (Rhudy et al., 2000). This possibility should be examined in future studies.

Theoretically, one implication is that the underlying mechanism of acculturation effect on pain is the unfamiliarity that immigrants are exposed to chronically. Future studies should examine how unfamiliarity has an effect on pain, and whether such an effect is limited to acculturation context or extends to a more general context. Practically, this research informs which group of immigrants are particularly vulnerable to greater amount of pain, and how it can be reduced. Late immigrants, particularly for those with a lower sense of control, tended to experience greater pain. For early immigrants, those who are not acculturated to the mainstream society are also at risk of greater pain sensitivity. Increasing the degree of familiarity, such as providing translation during any kind of pain procedure, may reduce the amount of pain for immigrants.

This study adopts a unidimensional model of acculturation in that the progress of acculturation is a linear progression across time. Unidimensional model of acculturation represents an early model of acculturation and bidimensional model may be a better conceptualization of acculturation. However, evidence has suggested taht unidimensional model is more applicable to overseas-born immigrants while the bidimensional model is more applicable to those who are exposed to multiple cultures from birth (Tsai & Chentsova-Dutton, 2002). Since the current research examines overseas-born immigrants, adopting a unidimensional model may still be suitable. However, the possibility of how bidimensional model of acculturation is predictive of pain responses should be examined in the future.

Table 1

Demographics of participants in Study 1.

Variables	Mainland Chinese Immigrants (n = 80)
Age	21.45 (1.77)
Gender (% female)	50.00
Length of stay	11.13 (4.63)
Mainstream identification	6.73 (0.99)
SES	3.51 (1.58)
Pain threshold	42.73 (2.26)
Pain tolerance	47.15 (3.20)

Numbers are means (with the exception of gender), and standard deviations, which are reported inside parentheses.

Table 2

Zero-Order Correlations among variables in Study 1.

Variables (range)	1	2	3	4	5	6	7
1. Pain threshold	--						
2. Pain tolerance	.699**	--					
3. Gender (0=Male)	-.352**	-.485**	--				
4. Age	.188	.174	-.170	--			
5. Length of stay	.354**	.186	-.097	-.117	--		
6. Mainstream ID	.162	.172	.009	-.066	.204	--	
7. SES	.060	.278*	-.028	.157	-.171	-.130	--

* $p<.05$ ** $p<.01$

Table 3

Regression on pain tolerance in Study 1.

	β	ΔR^2
Step 1		.053
Length of stay	.157	
Mainstream identification	.140	
Step 2		.122**
Length of stay	.116	
Mainstream identification	.312**	
Length of stay* Mainstream identification	.388**	

* $p<.05$ ** $p<.01$

Table 4

Regression on pain tolerance in Study 1.

	β	ΔR^2
Step 1		.133**
Length of stay	.240*	
SES	.319**	
Step 2		.058*
Length of stay	.290**	
SES	.281**	
Length of stay* SES	-.251*	

* $p<.05$ ** $p<.01$

Table 5

Demographics of participants in Study 2.

Variables	Mainland Chinese Immigrants (n = 48)	Hong Kong non-immigrants (n = 103)
Age	20.10 (2.20)	20.35 (3.23)
Gender (% female)	60.40	50.50
Control	3.75 (0.98)	3.71 (0.99)
Finger-pricking	31.45 (21.55)	25.24 (19.98)
Needle-insertion	30.10 (19.11)	30.30 (18.96)

Numbers are means (with the exception of gender), and standard deviations, which are reported inside parentheses.

Table 6

Zero-Order Correlations among variables in Study 2.

Variables (range)	1	2	3	4	5
1. Finger-pricking	--				
2. Needle-insertion	.613**	--			
3. Gender (0=Male)	.347**	.212**	--		
4. Age	-.163	-.233	-.154	--	
5. Control	-.049	-.108	-.034	-.103	--

* p<.05 ** p<.01

Table 7

Regression on finger-pricking pain rating in Study 2.

	β	ΔR^2
Step 1		.022
Immigration status	.142	
Perceived control	-.052	
Step 2		.050*
Immigration status	.145	
Perceived control	.060	
Immigration status* perceived control	-.200*	

* $p<.05$ ** $p<.01$

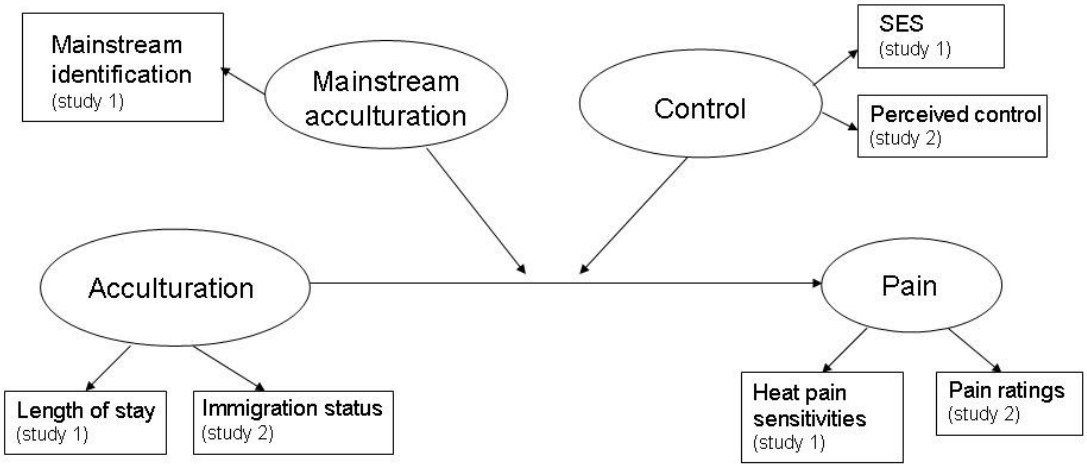

Figure 1. Conceptual model across study 1 and study 2.
(Circle denotes factor; rectangle denotes operationalization in each study.)

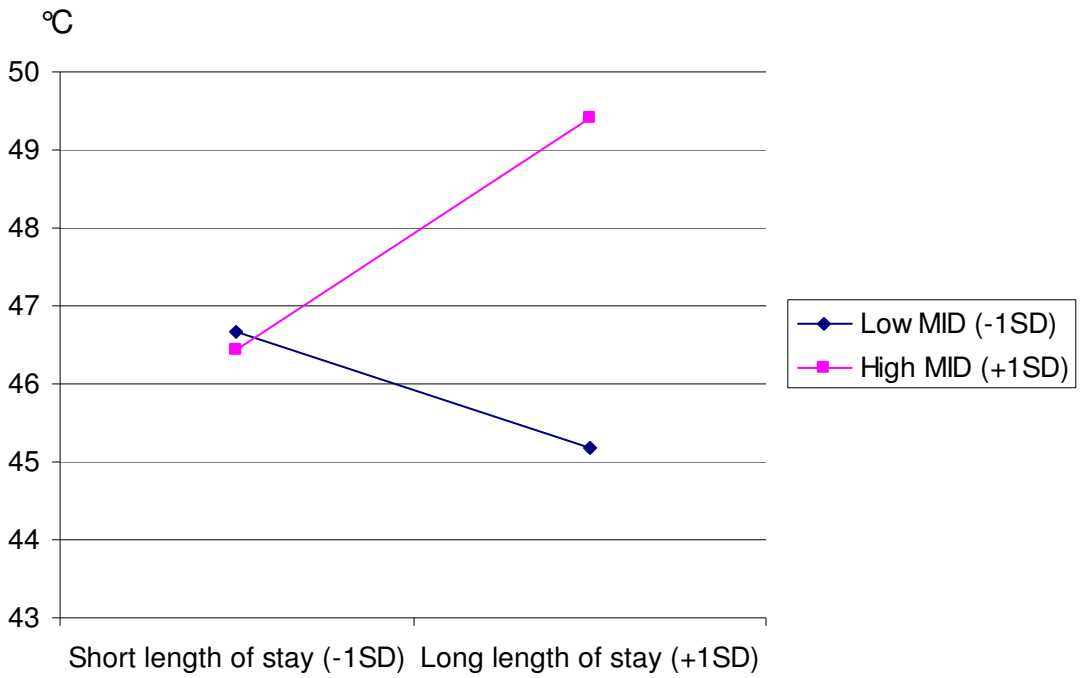

Figure 2. Interaction of length of stay and mainstream identification (MID) in predicting pain tolerance (Study 1)

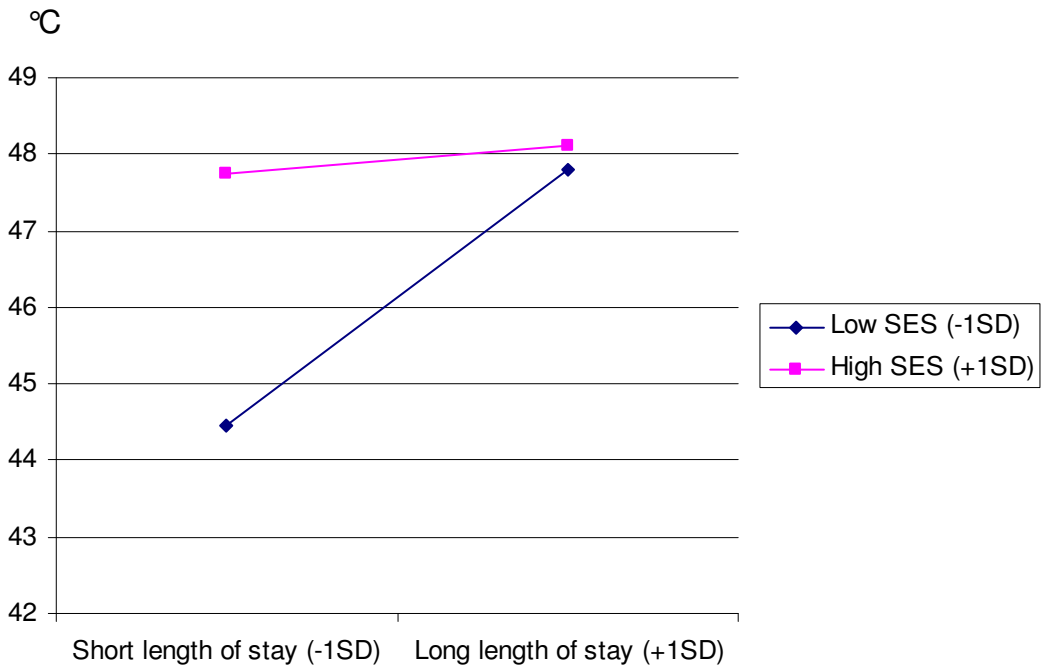

Figure 3. Interaction of length of stay and SES in predicting pain tolerance (Study 1)

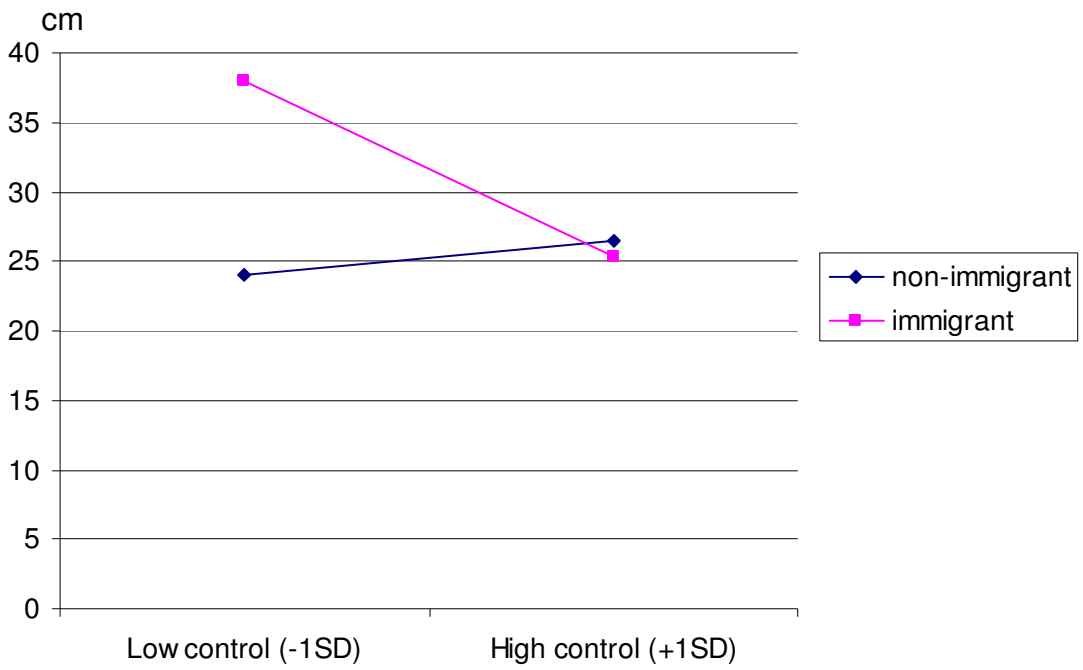

Figure 4. Interaction of immigration status and control in predicting pain tolerance (Study 2)

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